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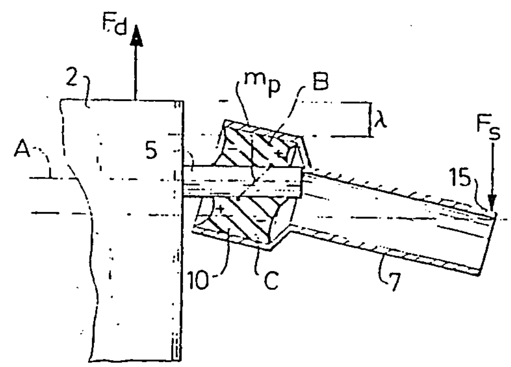
(58) Field of search
B4K

(54) Vibration damping handgrip

(57) An outwardly projecting handgrip (7) is connected to the machine via a rubber damping element (10) firmly connected to a shaft (5) on the machine and to the handgrip (7), the element having a length such that the location of the moment point in the element in which, when a force (F_s, F_d) is applied to the handgrip, a change from pressure force to tensile force takes place, lies between the machine housing (2) and the centre point of the handgrip and having a thickness and rigidness such as to permit the handgrip to be pivoted on each side of a reference line (A), in correspondence with the applied static pressure force (F_s) and the dynamic vibration force.

Fig. 5



This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

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Fig. 1

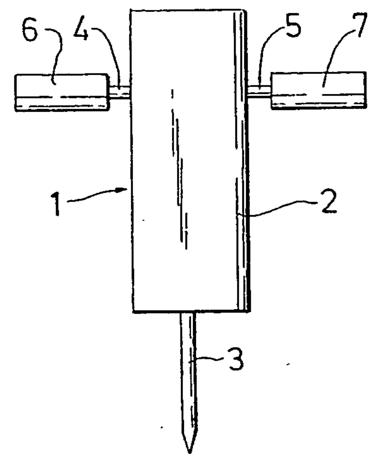


Fig. 2

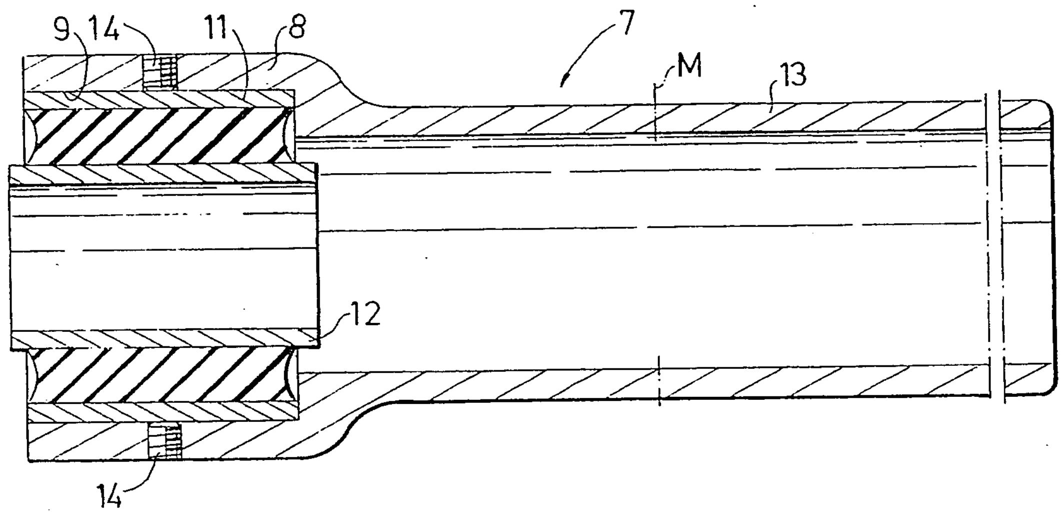


Fig. 3

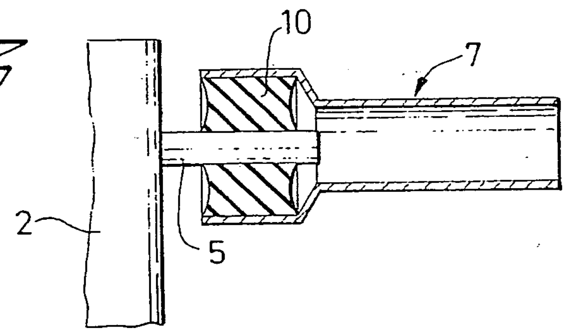


Fig-4

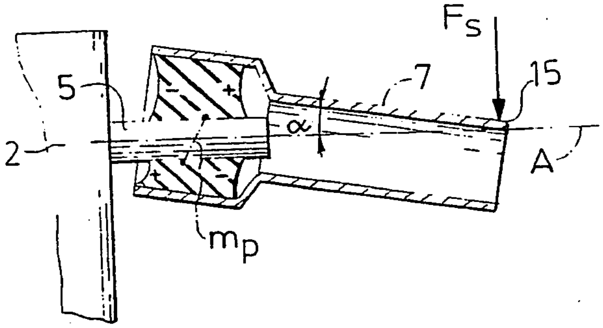


Fig-5

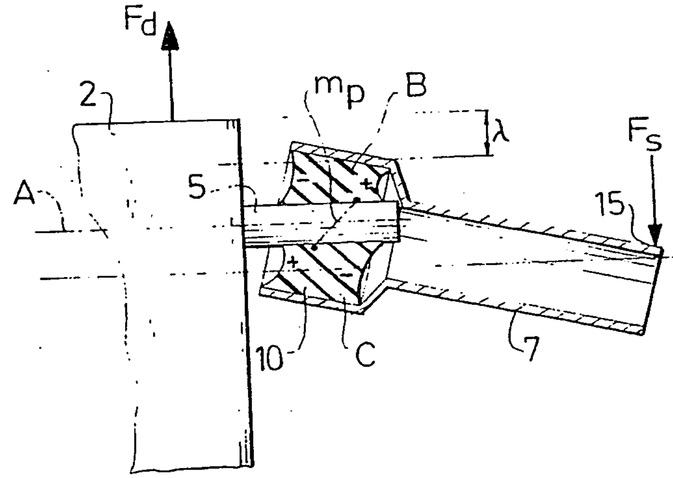
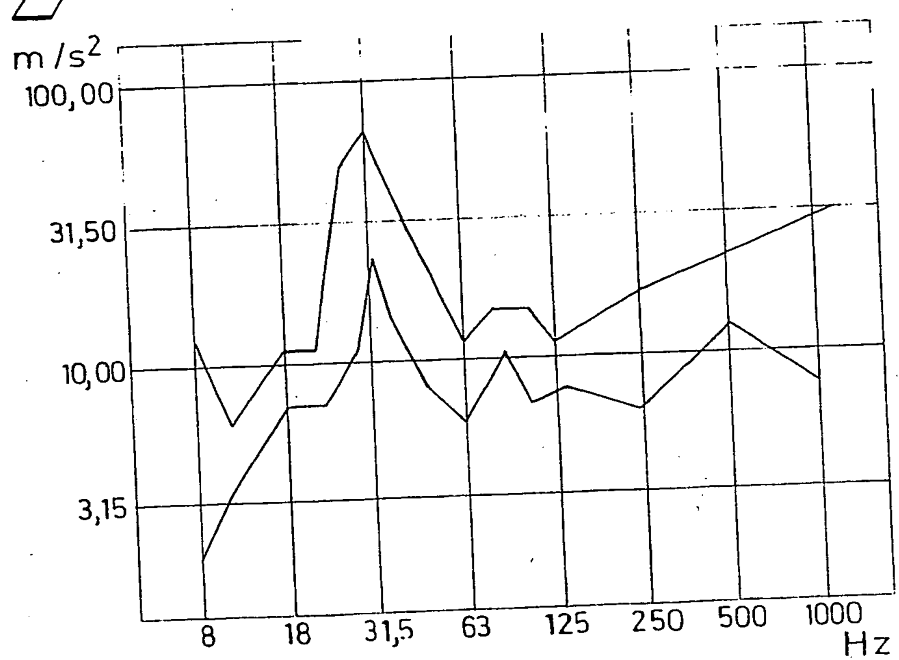


Fig-6



SPECIFICATION

A vibration-damping handgrip

The invention relates to an arrangement in a vibration-damping handgrip for use with a working machine, for example, a drilling machine or a chiselling machine, which generates vibrations when in operation, said handgrip being intended for mounting to a shaft connected to the machine housing by means of a sleeve-like element in the form of a hollow, rubber cylinder whose length is shorter than that of the handgrip.

Vibration-generating machines with which vibrations are transmitted to the hand of the operator often lead to a serious sickness known generally as "white hands", which is a direct result of the vibrations to which the hands are subjected and which is manifested by impaired blood circulation, and in certain cases may also damage the capillary vessels in the hands of the operator. Vibration-damping means used in this regard normally have the form of rubber sleeves or rubber composite bodies mounted between fixed shafts, projecting from the machine, and a surrounding sleeve-like grip. The damping effect afforded by such rubber anti-vibration mounts is relatively satisfactory in respect of high-frequency vibrations, but is unsatisfactory in respect of vibrations of frequencies beneath 5000 - 7000 Hz, even when the mounts are made of extremely thick and soft rubber.

Consequently, a prime object of the invention is to provide an arrangement of the kind defined in the introduction which is also able to provide considerable damping of low-frequency vibrations. The invention is based upon that property possessed by rubber whereby an increase in the length of a rubber element when subjected to tensile forces is proportionally greater than the change which occurs when the element is subjected to pressure forces, and that the transition between pressure force and tensile force in a part of the rubber element (moment point) constantly lies between the machine to which the handgrip is connected and the centre point of the handgrip. It will be understood that by rubber is meant natural rubber, synthetic rubber and mixtures thereof.

This object is fully realised by means of the invention, which is mainly characterised in that in an arrangement of the aforesaid kind the inner surface of the sleeve-like element is firmly connected, directly or indirectly, with said shaft and that the outer surface of said element is firmly connected, directly or indirectly, with the inner cylindrical surface of the handgrip; in that the sleeve-like element has an axial length such that that region of the force moment in said sleeve-like element within which, when forces are applied to the handgrip, a change takes place from a pressure force to a tensile force, lies between the machine housing and the centre point of the handgrip; and in that said sleeve-like element has a thickness and rigidness such as to permit the handgrip to pivot through an angle on each side of a central reference line passing through the shaft, in correspondence with the static pressure load applied to the handgrip and to the working machine, and the dynamic vibrational forces generated by said machine.

The sleeve-like element, which comprises a cylindrical rubber tube, is suitably firmly vulcanized to an inner steel tube, which is, in turn, firmly anchored to its associated shaft on the machine, and has an outer steel tube, to which the cylindrical outer surface of the rubber tube is firmly vulcanized, said outer steel tube being, in turn, firmly connected to the inner cylindrical wall of the handgrip, for example by means of one or more bolts or screws. It is possible, however, to vulcanize the rubber sleeve directly to the shaft and to the cylindrical wall of the handgrip respectively.

As will become apparent from the following description, the rubber element functions as a universal joint, utilizing the ability of the rubber to extend more readily than to become compressed under the action of the forces applied, wherewith the amplitude of vibrations and impact forces created by the machine are greatly equalized, and thus do not act upon the handgrip.

The invention will now be described with reference to the following drawings, in which:

Figure 1 illustrates a working machine in a highly simplified fashion, for example a hammer drill having two handgrips;

Figure 2 illustrates schematically an arrangement according to the invention, in which there is no load on the handgrips;

Figure 3 illustrates a handgrip provided with a damping sleeve-like element according to the invention;

Figure 4 illustrates the arrangment shown in Figure 3, with a pressure force applied to the handgrip;

Figure 5 illustrates the arrangement shown in Figure 4, when an impact force is generated by the machine; and

Figure 6 makes a comparison between the invention and known handgrips.

Figure 1 is a simplified illustration of a hammer-drill machine 1, having a machine housing 2, which accommodates, for example, a pneumatic drive motor arranged to drive an impact or hammer drill 3. Fixedly mounted on the machine housing 2 are two outwardly projecting shafts 4 and 5, which in the illustrated embodiment are shown to be mutually co-axial and diametrically opposed to one another. The shafts 4, 5, however, may be arranged to define an angle therebetween and need not be diametrically opposed. Arranged on each shaft 4,5 is a respective vibration-damping handgrip 6,7. One handgrip 7, which is identical to the handgrip 6, is illustrated in more detail in Figure 2. The end portion 8 of the handgrip 7 facing the machine 1 has formed therein a bore which has an inner cylindrical wall 9 and which accommodates a rubber, cylindrical damping element 10. Vulcanized to the outer cylindrical surface of the damping element 10 is a tube 11, which may be made of steel or some other suitable metal and which, in the illustrated embodiment, is substantially of the same axial length as the element 10. The inner cylindrical surface of the tube 11 may

be fixed to the outer cylindrical surface of the rubber element 10 in any other suitable manner, for example may be bonded with the aid of an adhesive. Similarly the inner cylindrical surface of the rubber element 10 is connected to the outer surface of a cylindrical metal tube 12, which has an inner cylindrical bore adapted to the shaft 5, so as to enable a firm connection to be made. For example, the inner cylindrical wall of the tube 12 may be so dimensioned ~~as to enable the~~ tube to be pressed hard and firmly onto the shaft 5, although the connection may also be made through the agency of screw threads. In the illustrated embodiment the outer part 13 of the handgrip 7 remote from the machine 1 is of tubular configuration and is of smaller diameter than the end portion 8; this outer part 13 is arranged to be gripped by the hand of the workman during operation and preferably lies well away from the rubber element 10. In the Figure 2 embodiment, the connection between the end portion 8 and the tube 11 has been effected with the aid of screws 14.

The operational mode of the novel arrangement will now be described with reference to Figurs 4 and 5. Figure 4 illustrates the handgrip when the tool 3 of the machine is is brought to bear against the surface to be worked and the operator exerts a pressure F_s on the two handgrips 6 and 7. The handgrip 7, and of course also the handgrip 6, will then swing in the direction of the force F_s, to form an angle α with the centre line A of the shaft 5. In the illustrated embodiment it is asumed that the handgrip 7 is straight and co-axial with the shaft. However, when the handgrip portion 13 is formed in a special manner, as a result of demands of an ergonometric nature placed thereupon such that the handgrip 7 and the shaft 5 have no common centre line, the reference line A refers instead to the shaft 5 and the centre line of the rubber sleeve 10, this latter centre line coinciding with the centre line of the shaft. When the handgrip is bent down, which in this embodiment is assumed to take place vertically, the rubber will be subjected to both tensile and pressure forces. The tensile forces have been indicated with a minus sign and the pressure forces with a plus sign. The stresses in the rubber change sign approximately in the region marked *mp*, the moment point. When the machine is started, vibrations, dynamic forces, F_d of amplitude λ, are generated, as illustrated in Figure 5. This dynamic force F_d causes the rubber to be compressed within the region referenced B, but because less force is required to stretch the rubber than to compress it, a much greater stretch or increase in tensile stress is obtained within the region referenced C. At the opposite end of the rubber sleeve 10, i.e. the end thereof nearest the machine, this dynamic force results in a reduction in the pressure stresses and a reduction in the tensile stresses, i.e. the mp point is displaced, as illustrated. The overall result is that the handgrip 7 is moved upwards, in response to the dynamic force, and that the angle α is increased at the same time, by a corresponding amount, and when the thickness of the rubber damper, its length and the rigidness of the rubber are all selected so as to enable the rubber damper to pivot within an angular range determined by the static pressure force F_s and the dynamic pressure force F_1, the outer end 15 will always remain substantially still, i.e. vibrations are not transmitted to the outer end. It is obvious that the closer the hand approaches the machine and the rubber damping element the more the damping effect will taper off, but when calculated along the whole length of the handgrip, the damping effect is fully satisfactory, even in the case when one side of the hand partly overlaps the rubber sleeve-like element. The only essential requirement is that the moment transition point mp lies between the end of the handgrip 7 facing the machine housing 2 and the centre point M of the handgrip, and that the rubber element permits a pivoting action through angle α to take place.

Figure 6 illustrates the damping function of a conventional handgrip fitted with a rubber sleeve along the whole of its length (upper curve) and a handgrip according to the invention having the following measurements (bottom curve). The dynamic force, expressed as acceleration m/s^2 is plotted along the y-axis, while the vibration frequency is plotted along the x-axis.

The arrangement according to the invention comprises a handgrip 7 having a total length of 165 mm, a rubber sleeve having a length of 35 mm, an inner diameter of 25 mm, an outer diameter of 40 mm, and tubes 11 and 23 (Figure 2) having a wall thickness of 2 mm. The comparison handgrip (upper curve) was provided with a rubber damper of corresponding construction, having a total length of 165 mm. In this case, the shaft extended completely through the handgrip and the rubber damper. The area between the two curves corresponds to the energy absorbed by the arrangement according to the invention.

Practical tests have shown that the length of the rubber damper in independence upon vibration forces and vibration amplitudes generated by the machine preferably lies between 20 - 40% of the total length of the handgrip.

CLAIMS

1. An arrangement in a vibration-damping handgrip (7) for a working machine (1) which generates vibrations when in operation and which handgrip is arranged to be mounted on a shaft (4,5) connected to a machine housing (2) by means of a sleeve-like element (10) in the form of a hollow rubber cylinder whose length is shorter than that of the handgrip (7) characterised in that the inner surface of the sleeve-like element (10) is firmly connected, directly or indirectly, with the shaft (4,5) and the outer surface of said element is firmly connected, directly or indirectly, with the inner cylindrical surface of the handgrip (7), and has a length such that the location of the moment point in said sleeve-like element (10) within which, when forces (F_s, F_d) are applied to the handgrip, a change takes place from a pressure force to a tensile force, lies between the machine housing (2), and the centre point (M) of the handgrip; and in that the sleeve-like element has a thickness and rigidity such as to permit the handgrip to pivot through an angle on each side of a central reference

line (A) passing through the shaft, corresponding to the static pressure load (F_s) applied to the handle and to the working machine and the dynamic vibrational forces (F_d) of said working machine.

2. An arrangement according to claim 1, characterised in that the axial length of the sleeve-like element (10) is 20 - 40% of the length of the handgrip.

3. An arrangement according to claim 1 or claim 2, characterised in that the sleeve-like element (10) is firmly connected through its cylindrical outer surface directly with the inner cylindrical surface of the handgrip, and is directly connected through its inner cylindrical surface with the surface of the shaft (4,5).

4. An arrangement according to claim 1 or claim 2, characterised in that the cylindrical outer surface of the sleeve-like element (10) is connected to the inner surface of a first metal tube (11) which is firmly mounted in the handgrip; and in that the inner cylindrical surface of the sleeve-like element is firmly connected to the outer cylindrical surface of a second tube (12), which is firmly connected with the shaft (4, 5).

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